

CLAIMS

What is claimed is:

1. A pressure compensation circuit for a hydraulic system having a primary pump and a secondary pump connected to a supply line, a return line connected to a system tank, at least one hydraulic service connected to a supply line and a return line, and a load-sense circuit which senses a load pressure at each hydraulic service, the pressure compensation circuit comprising:

a check valve connecting the secondary pump to the supply line and preventing fluid flow from the supply line to the secondary pump;

a first bypass compensator valve selectively providing a path between the supply line and the return line in response to pressure in the supply line being greater than pressure in the load-sense circuit by at least a first amount; and

a second bypass compensator valve selectively providing a path between the second outlet of the secondary pump and the return line in response to pressure in the supply line being greater than pressure in the load-sense circuit by at least a second amount, wherein the second amount is less than the first amount.

2. The pressure compensation circuit as recited in claim 1 further comprising

a first orifice coupling the load-sense circuit to a first node to which the first bypass compensator valve is connected; and

a second orifice coupling the load-sense circuit to a second node to which the second bypass compensator valve.

3. The pressure compensation circuit as recited in claim 2 further comprising a load-sense relief valve providing a path between the first node and the return line in response to pressure at the first node exceeding a given threshold.

4. The pressure compensation circuit as recited in claim 2 further comprising an unloader relief valve providing a path between an outlet of the secondary pump and the return line in response to pressure at the second node exceeding a given threshold.

5. The pressure compensation circuit as recited in claim 2 further comprising a solenoid operated relief valve providing a path between the first node and the return line when activated.

6. The pressure compensation circuit as recited in claim 1 wherein the load-sense circuit produces a first pressure on a first load-sense line indicating load pressure at a first hydraulic service and produces a second pressure on a second load-sense line indicating load pressure at a second hydraulic service; and further comprising:

a first orifice coupling the first load-sense line to the first bypass compensator valve;

a second orifice coupling the second load-sense line to the second bypass compensator valve; and

a third orifice connected between the first load-sense line and the second load-sense line.

7. The pressure compensation circuit as recited in claim 6 further comprising a check valve connected in parallel with the third orifice.

8. The pressure compensation circuit as recited in claim 6 further comprising:
a first node between the first orifice and the first bypass compensator valve;
a second node between the second orifice and the second bypass compensator valve;
a load-sense relief valve providing a path between the first node and the return line in response to pressure at the first node exceeding a given threshold; and
an unloader relief valve providing a path between an outlet of the secondary pump and the return line in response to pressure at the second node exceeding a given threshold.

9. A pressure compensation circuit for a hydraulic system having a primary pump and a secondary pump connected to a supply line, a return line connected to a system tank, at least one hydraulic service connected to a supply line and a return line, and having a load-sense circuit producing a pressure on a load-sense line corresponding to a greatest load among each hydraulic service, the pressure compensation circuit comprising:

a first orifice coupling the load-sense line to a first node;

a first bypass compensator valve selectively providing a path between the supply line and the return line in response to pressure in the supply line being greater than pressure at the load-sense line;

a second orifice coupling the load-sense line to a second node; and

a second bypass compensator valve selectively providing a path between the second outlet of the secondary pump and the return line in response to pressure in the supply line being greater than pressure at the second node.

10. The pressure compensation circuit as recited in claim 9 further comprising a load-sense relief valve providing a path between the first node and the return line in response to pressure at the first node exceeding a given threshold.

11. The pressure compensation circuit as recited in claim 9 further comprising an unloader relief valve providing a path between an outlet of the secondary pump and the return line in response to pressure at the second node exceeding a given threshold.

12. A pressure compensation circuit for a hydraulic system having a primary pump and a secondary pump connected to a supply line, a return line connected to a system tank, at least one hydraulic service connected to a supply line and a return line, and having a load-sense circuit producing a first pressure on a first load-sense line indicating load pressure at a first hydraulic service and producing a second pressure on a second load-sense line indicating load pressure at a second hydraulic service, the pressure compensation circuit comprising:

- a first orifice coupling the first load-sense line to a first node;
- a second orifice coupling the second load-sense line to a second node;
- a third orifice coupling the first load-sense line to the second load-sense line;
- a first bypass compensator valve selectively providing a path between the supply line and the return line in response to pressure in the supply line being greater than pressure at the load-sense line; and
- a second bypass compensator valve selectively providing a path between the second outlet of the secondary pump and the return line in response to pressure in the supply line being greater than pressure at the second node.

13. The pressure compensation circuit as recited in claim 12 further comprising a check valve connected in parallel with the third orifice.

14. The pressure compensation circuit as recited in claim 12 further comprising a load-sense relief valve providing a path between the first node and the return line in response to pressure at the first node exceeding a given threshold.

15. The pressure compensation circuit as recited in claim 12 further comprising an unloader relief valve providing a path between an outlet of the secondary pump and the return line in response to pressure at the second node exceeding a given threshold.

16. A hydraulic system comprising;

- a supply line for connection to at least one hydraulic service;
- a return line for connection to each hydraulic service;
- a primary pump connected to a supply line;
- a secondary pump connected by a check valve to a supply line;
- a load-sense circuit producing a pressure on a load-sense line corresponding to a greatest load among each hydraulic service;
- a first orifice coupling the load-sense line to a first node;
- a first bypass compensator valve selectively providing a path between the supply line and the return line in response to pressure in the supply line being greater than pressure at the first node;
- a second orifice coupling the load-sense line to a second node; and
- a second bypass compensator valve selectively providing a path between the second outlet of the secondary pump and the return line in response to pressure in the supply line being greater than pressure at the second node.

17. The pressure compensation circuit as recited in claim 16 further comprising a load-sense relief valve providing a path between the first node and the return line in response to pressure at the first node exceeding a given threshold.

18. The pressure compensation circuit as recited in claim 16 further comprising an unloader relief valve providing a path between an outlet of the secondary pump and the return line in response to pressure at the second node exceeding a given threshold.

19. The pressure compensation circuit as recited in claim 16 further comprising a solenoid operated relief valve providing a path between the first node and the return line when activated.

20. The pressure compensation circuit as recited in claim 16 further comprising a check valve coupling the second outlet to the supply line and allowing fluid to flow only from the secondary pump to the supply line.